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The use of near infrared spectroscopy (NIR) to estimate fire severity and effects on soils

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NIR has developed rapidly over the last several decades as a fast and robust analytical method for many agricultural, pharmaceutical and food products. This technique obtains the reflectance spectra of a sample in the range of the near infrared region (750-2500 nm $\approx$ 12000-4000 cm^{-1}). Near infrared radiation is absorbed by the different chemical bonds, such C-H, N-H, C-O and O-H of the organic compounds present in the sample. The infrared spectrum is the result of the overtones and combinations of fundamental vibrational bands for these bonds; as a consequence, an infrared spectrum contains information about the organic composition of the sample. In this sense, NIR coupled with chemometric techniques has been used to estimate some parameters related to the chemical composition of a broad spectrum of materials, including soils. In the case of soils, many organic fractions and other parameters related to soil quality have been predicted with NIR. Several important fractions of the carbon in soils, such as the organic carbon, the potentially mineralizable carbon and the carbon stored in the microbial biomass have been estimated by several authors using NIR. Most of these parameters are modified by the effect of fire.

NIR is a non-destructive technique which allows in a few seconds, and without laborious sample pre-processing, the obtention of the soil spectral. The soil sample pretreatment is fast and easy, needing only air-drying and sieving. Thus, several hundred of soil samples can be measured per day in the laboratory.

NIR could be used to monitor the changes caused by forest fires in a large number of soil samples. This technique offers, amongst others, the possibility of research into

the spatial pattern of fire effects on different fractions of carbon in soils, which needs a large number of samples.

Moreover, NIR spectroscopy offers a new perspective on the research fields of fire effects and fire ecology because it could estimate the fire severity on soil with better precision than other techniques. The maximum temperature reached in the soil during the wildfires could easily be estimated 'a posteriori'. Moreover, the time of the heating could also be estimated. Different statistical procedures such as cluster analysis could help to classify the fire severity in a soil sample.

In Mediterranean conditions, wildfires can start degradation processes of soils. Most of these processes are associated with fire severity. It is important to carry out rehabilitation practices before the start of the degradation processes. For a correct planning of the rehabilitation strategies, and to choose the best method it is necessary to obtain maps of severity (with a better resolution than remote sensing) and in a short time after the fire. These tasks need large numbers of samples, and could be easy carried out by NIR at a lower cost, and several times faster, than through classical methods of soil analysis.

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